BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

JAPANESE PATENT OFFICE -- Patent Abstracts of Japan

Publication Number: 09127132 A

Date of Publication: 1997.05.16

Int.Class: G01N 35/10

Date of Filing: 1995.10.31

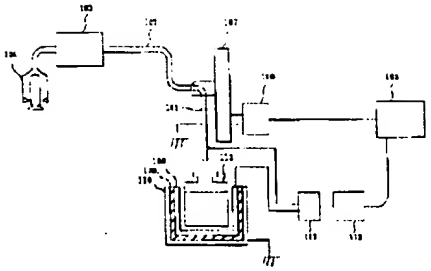
Applicant: HITACHI LTD
Inventor: TANAKA KAZUHIRO

LIQUID-LEVEL DETECTOR

Abstract:

PROBLEM TO BE SOLVED: To detect precisely the liquid level even in the use of a suction nozzle having the capability of sending a sample liquid and the like to some other parts by grounding the suction nozzle acting as one electrode, and shielding the outer wall of a liquid container housing acting as the other electrode, in turn serving as a detecting electrode.

SOLUTION: A suction nozzle 101 formed out of a conductive material, acting as one electrode, is grounded, and a container housing having a threefold structure, consisting of a container 10 made of conductive material containing a sample liquid and reagent therein, an insulator 9, and a conductive metal shield 110, is served as a detecting electrode, and these two electrodes considered as capacitance type electrodes are connected to a capacitance measurement part 111. A computer 105 controls a vertical nozzle motion mechanism 107 by driving a motor 106 and lowers a suction nozzle 101 and sends an output signal of the measurement part 111 to a liquid-level detecting part 112. The computer 105 judges whether the nozzle 101 comes into contact with the surface of liquid based on a signal from the liquid-level detecting part 112 and then ceases lowering the nozzle 101 by shutting off the motor 106.



Laid-Open Official Gazette
Laid-Open Patent Hei 9-127132 (Laid-Open: May 16.1997)
Applicant: Kabushiki Kaisha Hitachi Seisakusho

【Title of the Invention】 liquid level Detector

【Claims】

【Claim 1】

A liquid level detector using electrostatic capacitance method of which sucking nozzle, as a liquid level detecting means which detects a contact of a liquid-sampling means taking a sample liquid from a liquid container with the liquid surface moving up-and-down relative to the liquid surface, the nozzle serves also as an electrode and a housing of said liquid container serves also as another electrode, characterized in that: said sucking nozzle as an electrode is grounded, said housing of the liquid containers as another electrode is used as a detection electrode where the outer wall of said container housing is shielded.

【Detailed Description of the Invention】

【0001】

【Technical Field to which the Invention belongs】

The present invention relates to a liquid level detector of a sample liquid in a sample container, in particular, to a liquid level detector of a sample liquid in a sample liquid container or reagent liquid in a reagent container in an automatic analyzing device.

【0002】

【Prior Arts】

As a pretreatment of measurements using automatic analyzers which perform automatic analysis of sample liquids, there is a process in which a sample liquid and a reagent are taken into an analyzing device and the sample and the reagent are reacted. In this process, an accurate sampling is mandatory for precise measurement.

【0003】

Sampling of the sample liquid or the reagent is done by immersing a sucking nozzle in the sample liquid or the reagent, and the nozzle sucks the liquid using a sucking means such as a syringe. Then, the nozzle containing sucked sample liquid

or reagent is immersed in a reaction liquid and the sample liquid or reagent is discharged into the reaction liquid by a syringe or the like.

【0004】

In this case, it is necessary to minimize an immersion depth of the sucking nozzle in the sample liquid or reagent. As the sample liquid or the reagent adheres to the nozzle outer surface when the nozzle is immersed in the sample liquid or reagent, the nozzle outer surface must be washed. However the nozzle cannot be washed out completely in case the nozzle is immersed deeper than necessary, consequently the adhered materials are mixed in the reaction liquid, other sample liquid or other reagent, which deteriorates the accuracy of the measurement. Therefore, it is necessary to minimize the immersion depth of the nozzle in the sample liquid or the reagent by detecting the level of the sample liquid or reagent. And as a large amount of washing liquid is required for washing the outer surface, it is not economical as well. Therefore the function to detect a contact of the sucking nozzle to a liquid surface is required for the sucking process of the sample liquid or reagent to minimize the immersion depth of the sucking nozzle.

【0005】

There are several methods to detect a contact to a liquid level, and one of which is an electrostatic capacitance method described in Laid-Open Patent Hei 1-178826. In this method, a housing of sample liquid containers or reagent containers and a sucking nozzle are made up of a conductive material respectively to form a pair of electrodes. And in this case, a sucking nozzle side electrode serves as a detection electrode and the container housing side electrode is grounded. Electrostatic capacitance between the electrodes is converted into an electric signal relating to the electrostatic capacitance by a conversion circuit. There is a change in electrostatic capacitance between the electrodes before and after the contact of the sucking nozzle to the liquid surface. When the change is detected, the nozzle is determined to reach the liquid surface and the nozzle descent is stopped.

【0006】

However, there are automatic analyzing devices, in which a sample liquid or a reagent sucked by a sucking nozzle is transferred through a flow path by a transfer means such as syringe directly to another location such as a flow cell.

【0007】

Generally sample liquids and reagents have an electric conductivity, and a washing liquid is necessary to wash out inside the flow cell after each measurement and the washing liquid also has an electroconductivity. When such electroconductive liquids are introduced to a flow path between the sucking nozzle and the flow cell, an electric potential between the flow path and the sucking nozzle will become the same.

【0008】

In such case, in conventional electrode constructions in which a sucking nozzle serves as a detection electrode, the whole flow path also acts as a detection electrode. When a shape of the flow path changes or when the sample liquid flow or the reagent flow changes, as the detector detects electrostatic capacitance change between the detection electrode and the ground other than the container housing of the analyzing device (for example frame GND), the detector cannot detect the electrostatic capacitance change caused by the contact of the sucking nozzle to the liquid surface independently. Consequently, a conventional sucking nozzle connected to the flow cell and the like cannot detect the liquid level, and materials adhered to outside the sucking nozzle have to be washed out with large amount of water.

【0009】

【Problems the Invention intends to solve】

The subject matter of this invention is to provide automatic analyzing devices with a electrostatic capacitance type liquid level detection function including a sucking nozzle having a sucking function of a sample liquid or reagent for transfer to another location such as a flow cell position.

【0010】

【Means to solve the problems】

In an automatic analyzer of the present invention, an electrostatic capacitance type liquid level detection function is realized by having an electrode configuration where the sucking nozzle, acts as an electrode, is grounded (GND), said container housing, acting as another electrode, serves as a detection electrode and the outer wall of the container housing is shielded.

【0011】

As the automatic analyzer of the present invention is provided with an

electrode construction where the said sucking nozzle acting as one electrode is grounded, the said container housing serves as a detection electrode and the outer wall of container housing is shielded, the automatic analyzing device of the present invention achieves the electrostatic capacitance method liquid level detection function with a sucking nozzle which has a function to send sample liquid or reagent to another location such as a flow cell position because the analyzer can detect independently the electrostatic capacitance change at the time of the contact of a sucking nozzle to liquid surface, even though electric conductive liquid is introduced into a flow path.

【0012】

【Mode of carrying out the Invention】

The present invention will be described referring to a concrete example.

【0013】

Figure 1 shows a block diagram of an example of a liquid level detector of the present invention.

【0014】

Sucking nozzle 101 in Figure 1 is connected to a flow cell 103 through a tube 102. A sample liquid or reagent and the like sucked by the sucking nozzle 101 is transferred to a flow cell with a syringe 104. The sucking nozzle 101 made of a conductive material acts as an electrode and is grounded (GND). The sucking nozzle 101 is made possible to move up-and-down by controlling a nozzle up-and-down mechanism 107 with a motor 106 and with a computer. A container 108 containing the sample liquid or reagent is installed in a container housing mentioned below. The container housing has a triple structure. The inside thereof is a detection electrode 108 made of a conductive material and the outside thereof is a shield 110 made of a high-conductive metallic material, and the electrode 108 and the shield 110 are insulated with each other by an insulator 109.

【0015】

The detection electrode 108 and the sucking nozzle 101 are connected to an electrostatic capacitance measuring part 111 as two electrodes of electrostatic capacitance type. An output signal of the electrostatic capacitance measuring part 111 is transferred to a liquid level detection part 112. Then the liquid level detection part 112 sends a liquid level detecting signal to the computer 105 and

when the computer 105 receives the liquid level detecting signal, the computer 105 stops the motor 106 to stop descent of the sucking nozzle 101.

【0016】

Figure 2 shows an explanatory diagram of an automatic analyzing device using a liquid level detector of the present invention.

【0017】

In Figure 2, a plural number of sample containers 201 are arranged on a sample disk 202 which can rotate with a motor. Similarly a plural number of reagent containers 204 are arranged on a reagent disk 205 which can rotate with a motor. A reaction vessel 207 is located on a reaction position 208. A pipetter 211 can move with a motor from above the sample sucking position 203 to above the reaction position 208 and from above the reagent sucking position 206 to above the reaction position 208 and also the pipetter can move up-and-down as well at each position. A sipper 212 can move freely with a motor between above the reaction position 208, above a buffer solution sucking position 215 and above an inside-the-flow-cell washing liquid sucking position 216 and also the sipper can move up-and-down at each position.

【0018】

And the sipper has a function to transfer the reaction liquid to a flow cell 214 through a flow path 213.

【0019】

The sipper 212 is equipped with the liquid level detector of the present invention. And the reaction vessel housing 217, the buffer solution container housing 218 and the inside-the-flow-cell washing liquid container housing 219 is made up of the triple structure consisting of the detection electrode 108, the insulator 109 and the shield 110. Respective electrostatic capacitance measuring parts 111 are separately prepared for the reaction vessel housing 217, the buffer solution container housing 218 and the inside-the-flow-cell washing liquid container housing 219. However the liquid level detection part 112 uses a one tip microcomputer in common with the reaction vessel housing 217, the buffer solution container housing 218 and the inside-the-flow-cell washing liquid container housing 219. The sucking nozzle of the sipper 212 acts as a ground (GND) in common with the reaction vessel housing 217, the buffer solution container housing 218 and the inside-the-flow-cell

washing liquid container housing 219.

【0020】

The pipetter 211 is equipped with a conventional liquid level detector.

【0021】

The pipetter 211 and the sipper 212 can wash the outer surface of the sucking nozzles at respective washing positions 210 and 209.

【0022】

These units can operate under the time-schedule control of the computer.

【0023】

The structure of the automatic analyzing device is described above, and the flow of the operation of the device equipped with the liquid level detector of the present invention will be described hereinafter.

【0024】

First, the sample disk rotates so that a sample container 201 containing a sample subject to analysis is at the sample sucking position 203. At the same time, the pipetter 211 moves to above the sample sucking position 203. The pipetter 211 moves downward and, when it reaches the liquid surface, the liquid level detector operates and stops the motor. The pipetter 211 sucks the sample in this condition. After sucking, the pipetter 211 moves upward and then moves to above the reaction position 208. The pipetter 211 moves downward and stops at an appropriate level and discharges the sample into the reaction vessel 207. After discharging, the pipetter 211 moves upward and then, moves to the washing position 210. When the pipetter 211 reaches the washing position 210, washing liquid spouts and washes the tip of the nozzle of the pipetter 211.

【0025】

Similarly, the pipetter 211 transfers reagents from the reagent sucking position 206 of reagent disk 205 to the reaction vessel 207.

【0026】

After a suitable reaction period, the sipper 212 moves to above the buffer solution sucking position 215. The sipper 212 moves downward, and when it reaches a liquid surface of the buffer solution, the liquid level detector of the present invention operates and stops the motor. The sipper sucks the buffer solution. Then the tip of the sipper 212 is washed at the washing position 209.

【0027】

Similarly, the sipper 212 sucks the reaction liquid at the reaction position 208. The buffer solution and the reaction liquid are simultaneously transferred to the flow cell 214 through the tube 213 and measurement was performed.

【0028】

The sipper sucks the inside-the-flow-cell washing liquid at the inside-the-flow-cell washing liquid sucking position 208, and similarly transfers the liquid through the tube 213 for washing inside the flow cell.

【0029】

Next, the functions are explained. In the case of sucking nozzles connected to a flow cell and the like, an electrostatic capacitance method liquid level detection, hitherto, cannot be achieved. When applying the electrode arrangement of the present invention, it can be achieved even with a sucking nozzle connected to a flow cell and the like, and consequently the measurement using a flow cell and the like will become more precise.

【0030】

【Effects of the Invention】

According to the present invention, as the liquid level detection which cannot be done with a sucking nozzle connected to a flow cell and the like becomes possible, the measurement is more precise, and amount of washing liquid for the out side wall of sucking nozzle can be decreased.

【Brief Description of Drawings】

【Figure 1】 A block diagram of a liquid level detector of the present invention.

【Figure 2】 An illustrative view of an automatic analyzing device using a liquid level detector of the present invention.

【Description of Symbols】

101…nozzle, 102…tube, 103…flow cell, 104…syringe, 105…computer, 106…motor, 107…up-and-down movement mechanism, 108…detection electrode, 109…insulator, 110…shield, 111…electrostatic capacitance measuring part, 112…liquid level detection part, 113…container.